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THE ROLE OF ANNOSUS ROOT DISEASE AND BORATE IN GIANT SEQUOIA MANAGEMENT

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Background

Pesticides containing borate (primarily borax and more recently Tim-Bor) have been used for several decades in California to control or minimize the introduction of annosus root disease caused by Heterobasidion annosum. Windborne spores produced by this pathogen can invade freshly cut stump surfaces, and if the fungus successfully colonizes the root system, it may create a new disease center. Properly applied, borax is at least 90% effective in preventing stump invasion by providing a toxic barrier to the fungus (Smith, 1970). Tests in California with Tim-Bor showed that it was just as effective, at label rates, as granular borax (DeNitto, 1994). It is Forest Service policy in Region 5 to treat all recently cut conifer stumps in developed recreation sites. Borate chemicals are also used frequently in California timber stands, especially in eastside pine and mixed conifer stands. A Forest Pest Management biological evaluation for the Tahoe National Forest (Kliejunas, 1991) summarizes current information on annosus in timber situations and includes a risk assessment for borax.

Stumps account for the initiation of most root disease centers in pine species (Bega, 1963). Stumps are also important in the infection of true firs, but in addition, mechanical wounds seem to play a significant role in allowing the introduction of annosus root disease (Aho, et.al. 1983; Aho, et.al., 1989). Wounds caused by fire have long been recognized as entry points for decay fungi (Whitney, 1988). In general, cutting trees and the damage associated with tree removal, account for much of the H. annosum infection in managed California conifer forests.

Two distinct forms, or types, of H. annosum exist in nature. The "P" (pine) type is pathogenic to pines, incense cedar, and western juniper, while the "S" (fir) type is pathogenic to true fir and giant sequoia (Ottosina, et. al. 1992). Douglas-fir is the only California conifer that has been reported as a host for both types of annosus. Neither type will cross over and infect species in the other host group. What can cause confusion in the field is that apparently the two pathogenic types can colonize and reside saprophytically in



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stumps of non-host conifer species. Thus, "P" type conks may be found in fir stumps, and "S" type conks may be found in pine stumps. In California, the pine type of annosus is most common in eastside Sierra Nevada and Southern California pine stands, while the fir type is most prevalent on red and white fir in both eastside and westside mixed conifer and red fir stands.

Giant sequoia is a host for the "S" type of annosus. Examinations of downed sequoias in the Sierra Nevada showed that annosus root disease was the most common factor in failures involving the root system (Piirto, 1977). In May, 1992, a 13-foot diameter sequoia fell in the Giant Forest area of Sequoia National Park. Observations at the failure scene revealed that exposed roots of the tree had root rot, and the tree was located within an annosus root disease center which was affecting mainly white fir (Pronos, 1992).

Conclusions/Recomendations

Research studies and field observations have provided the following information related to annosus root disease and giant sequoia:

1. Freshly cut stumps surfaces and wounds in true fir are effective entry courts for windborne spores of H. annosum.
2. Borate provides an effective barrier to the stump top invasion of annosus root disease spores.
3. Both true fir and giant sequoia are susceptible to the fir or "S" type of annosus.
4. Annosus root disease contributes to the failure of mature sequoias.

The evidence indicates that H. annosum can spread from true fir to giant sequoia, and there may be even a slight possibility that the fir type of annosus could spread to sequoia from infected pine stumps. Considering this information and the value of giant sequoia, borate treatment of all conifer stumps cut adjacent to sequoias is justified. Preventing mechanical wounds and fire damage to residual true fir is just as important.

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